

P.G. 1st Semester-2017**CHEMISTRY****(Physical)****Paper : MCHECCT-104**

Full Marks : 40

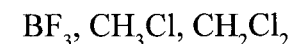
Time : 2 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer any **five** questions taking at least **two** from each Group:**GROUP-A**

1. a) Obtain the complete list of symmetry operations that are possible in a perfect tetrahedron.
- b) Find the matrix representations of all possible symmetry operations that are possible in ammonia molecule taking three unit vectors directed along three N-H bonds as basis.
- c) Which of the following point groups contain 'i' as a symmetry element?

 $D_{2d}, C_{2h}, D_{3d}, C_{4v}$ 3+4+1

2. a) Find the symmetry operations and hence the point group of ammonia molecule. Classify the elements into different classes.
- b) Find the point group of the following molecules:



- c) What is meant by a subgroup? Illustrate with an example. 3+3+2
3. a) Find the spectroscopic term symbol for the electronic configuration $1s^2 2s^2 2p^1 3p^1$. Hence, determine the term symbol for the configuration $1s^2 2s^2 2p^2$.
- b) Establish the Bohr's correspondence principle in case of a free particle moving in 1-D box of length L.
- c) What is Hermitian operator? 4+3+1
4. a) What are matter waves?
- b) Calculate the wavelength of an automobile of mass 1000kg moving with a velocity of 80 kmhr⁻¹.
- c) A ray of uv light of wavelength 3000 \AA falling on the surface of a metal, whose work function is 2.28 eV, ejects photoelectrons.

[Turn over]

Calculate the velocity of the emitted photoelectron.

$$[m=9.1 \times 10^{-31} \text{ kg, } h=6.56 \times 10^{-34} \text{ Js, } e=1.6 \times 10^{-19} \text{ C}] \quad 2+3+3$$

GROUP-B

5. a) What is hot band in vibrational spectra? Is it possible to see them at room temperature?
- b) Rotational Spectroscopy is the sophisticated method to determine the bond length in a molecule. How spectral information is related to bond length? 4+4
6. a) Classify each of the following molecules into oblate/prolate symmetric top:
 $\text{CHCl}_3, \text{C}_6\text{H}_6, \text{CH}_3\text{Cl}.$
- b) Two peaks in a low resolution NMR spectrum of CH_3CHO are separated by 7.6 ppm. What is the frequency difference in a 100 MHz spectrometer? $4\frac{1}{2}+3\frac{1}{2}$
7. a) What is diamagnetic circulation of electron? Give details.
- b) Explain shielding and deshielding by π -electrons. 4+4

8. a) Convert the spectroscopic terms:
2 nm to wave number
 10^{16} Hz to Joule
 3000 cm^{-1} to MHz
- b) Two NMR instruments A and B operate at 300 and 500 MHz. Which machine is better? Answer critically. 3+5